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Incisor inclination indicator for anterior torque control during retraction in lingual orthodontic treatment

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A device called incisor inclination indicator to control the axial inclinations of the incisors in the diagnostic setup is introduced. It is used to control the retraction of the maxillary and mandibular incisors. In this article, we describe the use of the incisor inclination indicator to prescribe adequate torque into the anterior lingual brackets and evaluate the results of treatment in a bimaxillary dentoalveolar protrusion case that underwent orthodontic treatment with the pretorqued anterior lingual brackets. Retraction of the maxillary and mandibular incisors was achieved with careful control of the axial inclination. It is indicated that the use of the incisor inclination indicator is an effective adjunctive laboratory procedure for anterior torque control during retraction in lingual orthodontic treatment.

Key words : Lingual orthodontic treatment, Incisor inclination indicator, Pretorqued anterior lingual bracket, Controlled retraction of the incisors

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Correct positioning of the maxillary and mandibular incisors is recognized to be essential for function, stability, and esthetics.[1-5] Retraction of the incisors therefore represents a fundamental and often critical stage in orthodontic treatment.

One of the most difficult problems to overcome in lingual orthodontic treatment has been torque control of the anterior teeth during space closure.[6,7] Anterior torque control is achieved either by directly applying a moment and force to a lingual bracket or by using lever-arm mechanics to apply the desired line of action of the force with respect to the center of resistance.[8-12]

Applying the moment or torque to the bracket in co-

Fig 1. Orientation of the face bow on the patient.
A: An anterior reference point (arrow) is marked at the lowest point of the infraorbital rim on the patient's right side; B: Earplugs of face bow are placed in the patient's external auditory meati. The bow is adjusted so that its anterior reference pointer aligns precisely with the anterior reference point on the patient's face. The upper surface of the bow visually represents FH plane.

ntinuous arch mechanics can be managed in two ways. First, needed torque can be placed in the customized bracket before treatment. Secondly, torque can be placed directly to the wire during treatment. As a practical matter, it is difficult to place third order bends in the anterior part of the lingual mushroom archwire. Therefore, it is recommended that needed torque is prescribed in the lingual brackets before treatment.

Because of the irregular morphology of the lingual tooth surfaces and the difficulty of access, an indirect bonding system must be used in lingual orthodontic treatment. In most lingual indirect bonding systems, the brackets are bonded to the diagnostic setup cast with a light-cured resin, and the angulation, torque, and in-out needed to achieve the desired tooth movements are built into the resin backings of the bracket bases.[13-18] According to the axial inclination of the incisors in the diagnostic setup, the amount of torque built into the anterior brackets varies. For best results, therefore, the diagnostic setup must suit the individual patient precisely.

In 1997, we introduced a device called incisor inclination indicator to control the axial inclinations of the incisors in the diagnostic setup.[19] With this, adequate torque can be built into the resin backings of the anterior lingual bracket bases and the unwanted lingual tipping of the incisors during retraction can be prevented by giving additional lingual root torque or not giving unnecessary lingual crown torque to the anterior bracket.

The purpose of this article was to demonstrate the usefulness of the incisor inclination indicator for torque control of the anterior teeth during retraction in a bimaxillary dentoalveolar protrusion patient. This article describes the use of the incisor inclination indicator to prescribe adequate torque into the anterior lingual bracket and presents the results of treatment in a bimaxillary dentoalveolar protrusion case that was treated with a pretorqued anterior lingual bracket.

PROCEDURE FOR PRESCRIBING ADEQUATE TORQUE INTO ANTERIOR LINGUAL BRACKETS WITH THE USE OF THE INCISOR INCLINATION INDICATOR

After marking an anterior reference point at the lowest point of the infraorbital rim, adjust the face bow so that its anterior reference pointer aligns precisely with the anterior reference point on the patient's face (Fig 1). The upper surface of the bow will now coincide visually with mechanical Frankfort Horizontal (FH) plane.

With the use of face bow and bite fork, mount the maxillary and mandibular casts on the articulator. Thus,

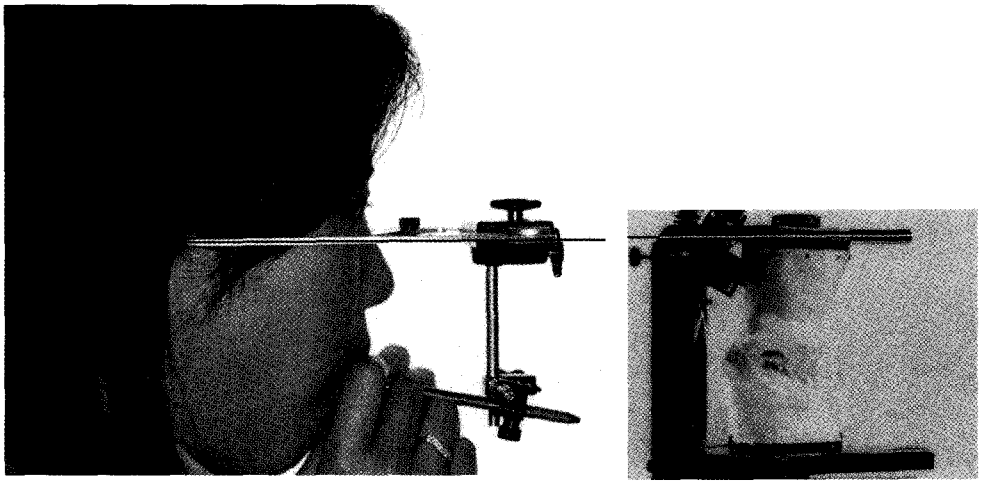

Fig 2. With the use of face bow and bite fork, the maxillary and mandibular casts are mounted on the articulator. The table top of the articulator coincides with FH plane.

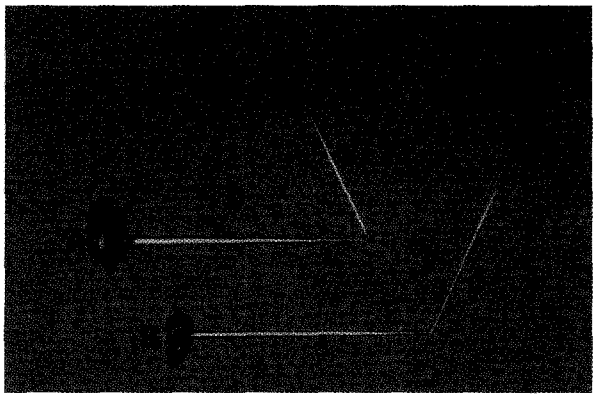

Fig 3. Incisor inclination indicators made from inlay pattern resin (a) and 0.021 × 0.025 inch stainless steel wire (b). A: Upper incisor indicator; B: Lower incisor indicator.

the table top of the articulator becomes coincidental with FH plane (Fig 2).

Make inclination indicators for the upper and lower incisors from 0.021 × 0.025 inch stainless steel wire and inlay pattern resin (Fig 3) and adjust each indicator on the cast so that its angle to the articulator table is the same as the inclination of the incisor to the FH plane on the cephalogram (Fig 4).

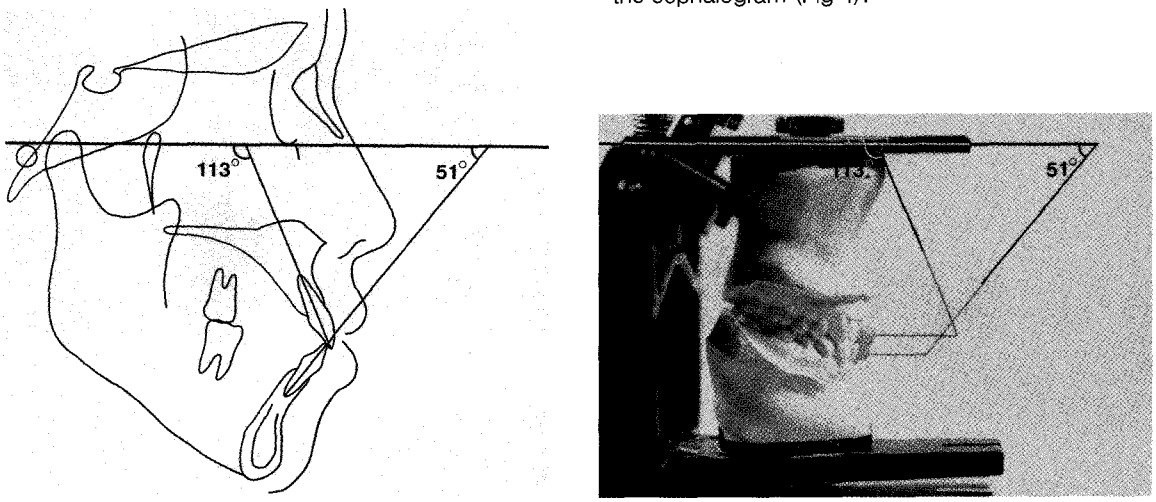

Fig 4. Using the protractor, each indicator is adjusted on the cast so that its angle to the articulator table is the same as the inclination of the incisors to FH plane on the cephalogram. In this case, the angle for the upper incisor is 113° and for the lower incisor, the angle is 51°.

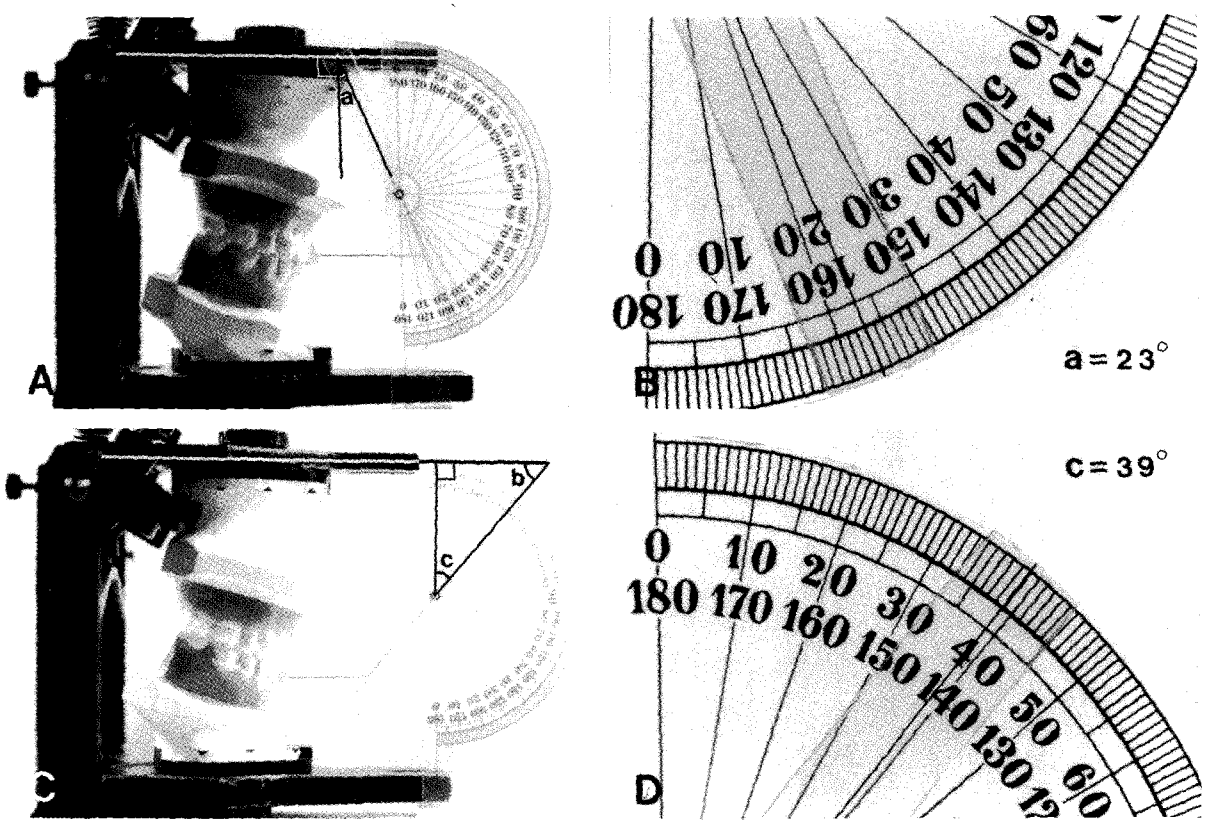

Fig 5. Using the inclination indicators and the protractor, the upper and lower incisors are repositioned according to treatment objectives. In this case, the treatment objectives are 113° for the upper and 51° for the lower incisor, which are the pretreatment value. A, B: Desired upper incisor axial inclination to articulator table: 90° + a = 90° + 23° = 113°; C, D: Desired lower incisor axial inclination to articulator table: b = 90° − c = 90° − 39° = 51°.

Using the inclination indicators and the protractor, reposition the teeth on the setup cast to achieve the desired axial inclinations of the upper and lower incisors to mechanical FH plane (Fig 5). The desired diagnostic setup is completed.

Using the special bracket-placement equipment,[18] bond the lingual brackets to the setup cast with a light-cured resin (Fig 6). Customized torque, angulation, and in-out are built into the resin on each bracket base.

From the setup cast, each customized lingual bracket is bonded to the appropriate tooth by individual transfer tray[18] and treatment starts (Fig 7).

CASE REPORT

The following clinical example shows the sequence of treatment that is usually followed.

A 26-year-old female came to the consultation with a chief complaint concerning protruded lips. She had a secondary concern about anterior crowding. Her medical and dental histories were noncontributory.

The patient exhibited a convex profile and a Class I canine and molar relationship, with an overjet of 2.3 mm and an overbite of 0.5 mm (Fig 8). There were maxillary arch crowding of 2.6 mm and mandibular arch crowding of 3.0 mm.

Cephalometric analysis disclosed a Class I skeletal relationship with proclined upper and lower incisors and

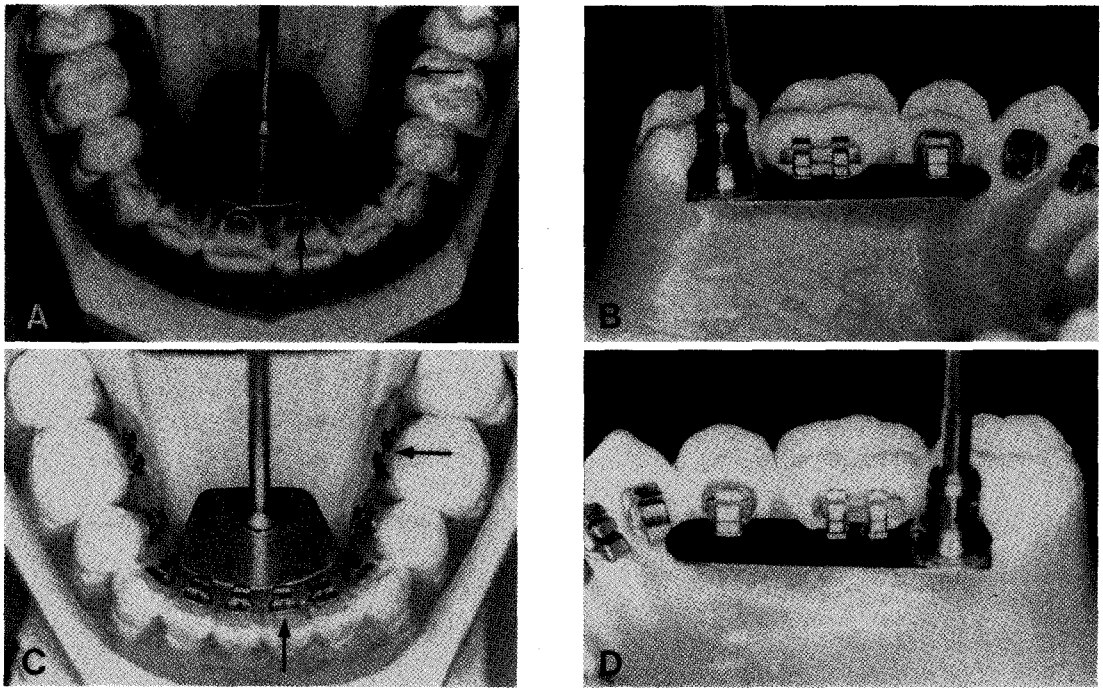

Fig 6. Placement of lingual brackets on ideal setup, using the special bracket-placement equipment. Customized torque and in-out are built into the resin (arrow) on each bracket base. A: Maxillary anterior brackets; B: Maxillary posterior brackets; C: Mandibular anterior brackets; D: Mandibular posterior brackets.

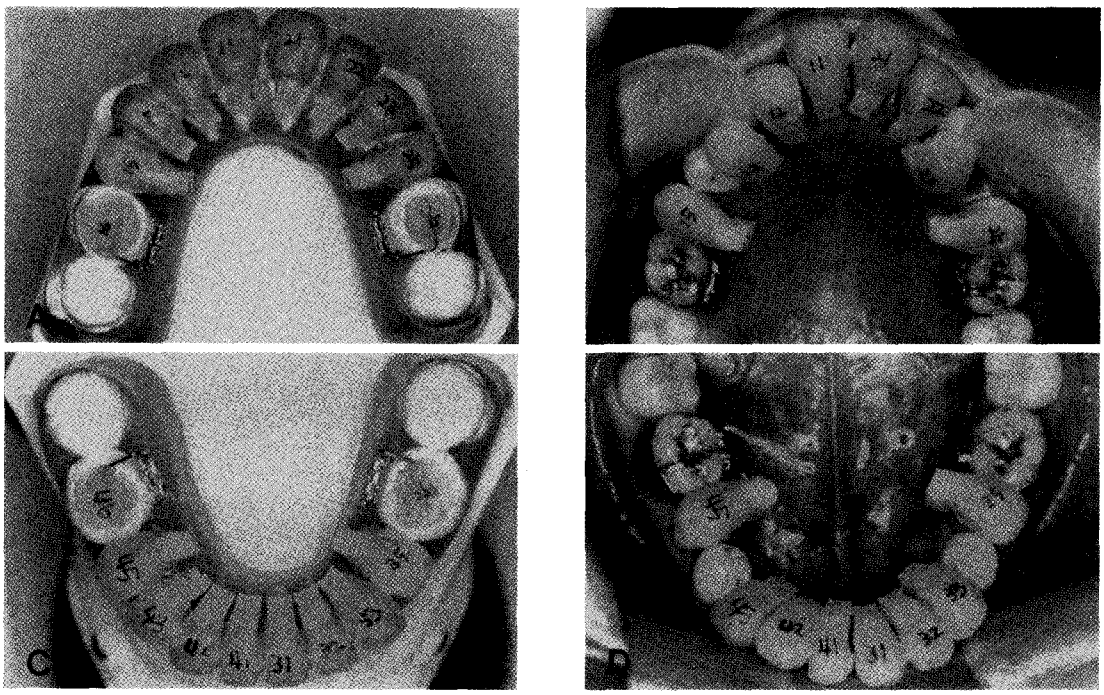

Fig 7. Delivery of each customized lingual bracket from the setup cast to the appropriate tooth by an individual transfer tray. A, B: Maxillary brackets; C, D: Mandibular brackets.

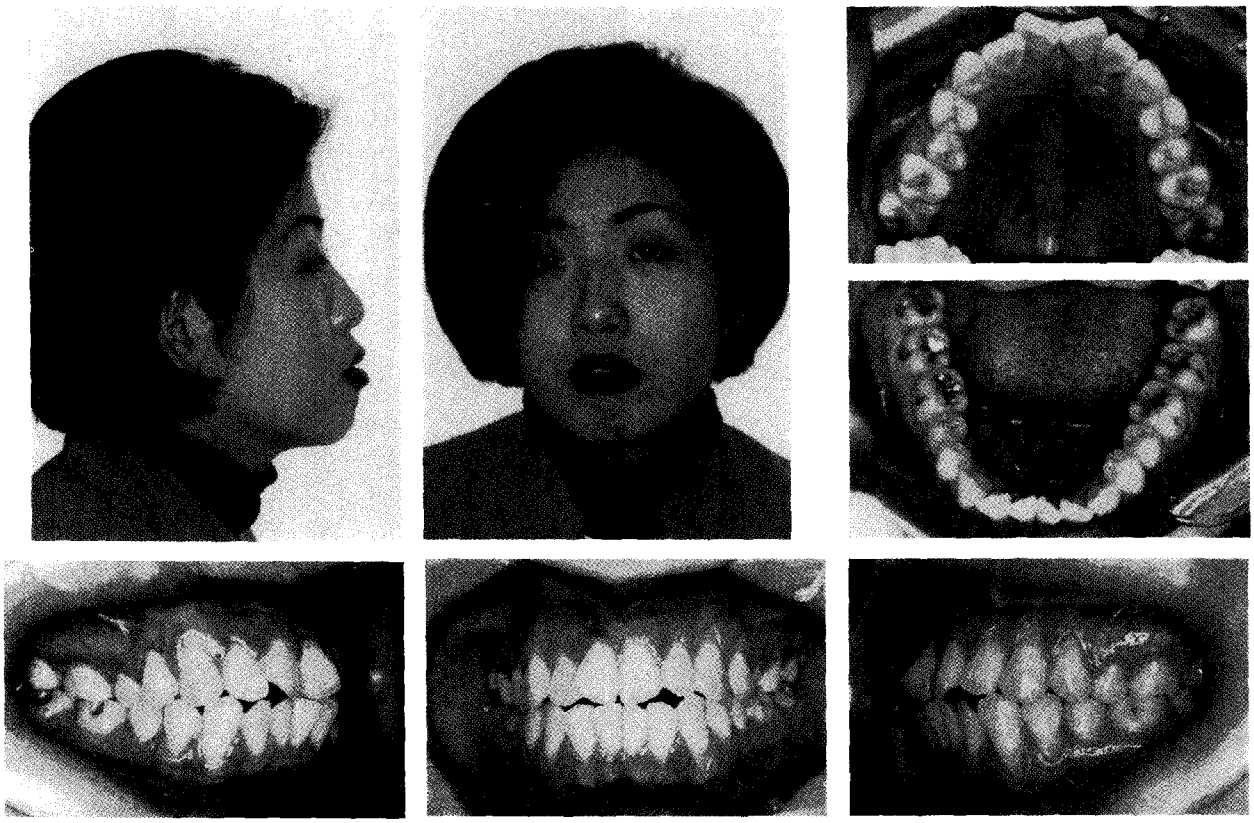

Fig 8. Pretreatment facial and intraoral photographs.

Table 1. Cephalometric summary

Measurement	Norms	Pretreatment	Posttreatment
Skeletal			
SNA(°)	81.6	80.1	80.1
SNB(°)	79.2	77.5	76.9
ANB(°)	2.5	2.5	3.2
FMA(°)	24.3	31.8	31.3
NPo-FH(°)	89.1	84.9	85.0
LAFH(㎜)	72.2	75.6	75.5
Dental			
Overbite(㎜)	1.8	0.5	2.0
Overjet(㎜)	3.5	2.3	2.0
$\underline{1}$-FH(°)	111.1	116.3	110.5
FMIA(°)	54.9	45.3	52.2
Interincisal(°)	124.1	109.0	121.7
Soft tissue			
Upper lip to E-line(㎜)	-0.9	2.0	0.0
Lower lip to E-line(㎜)	-0.6	7.0	3.0

Note that the FH plane used in skeletal and dental measurements is anatomical.

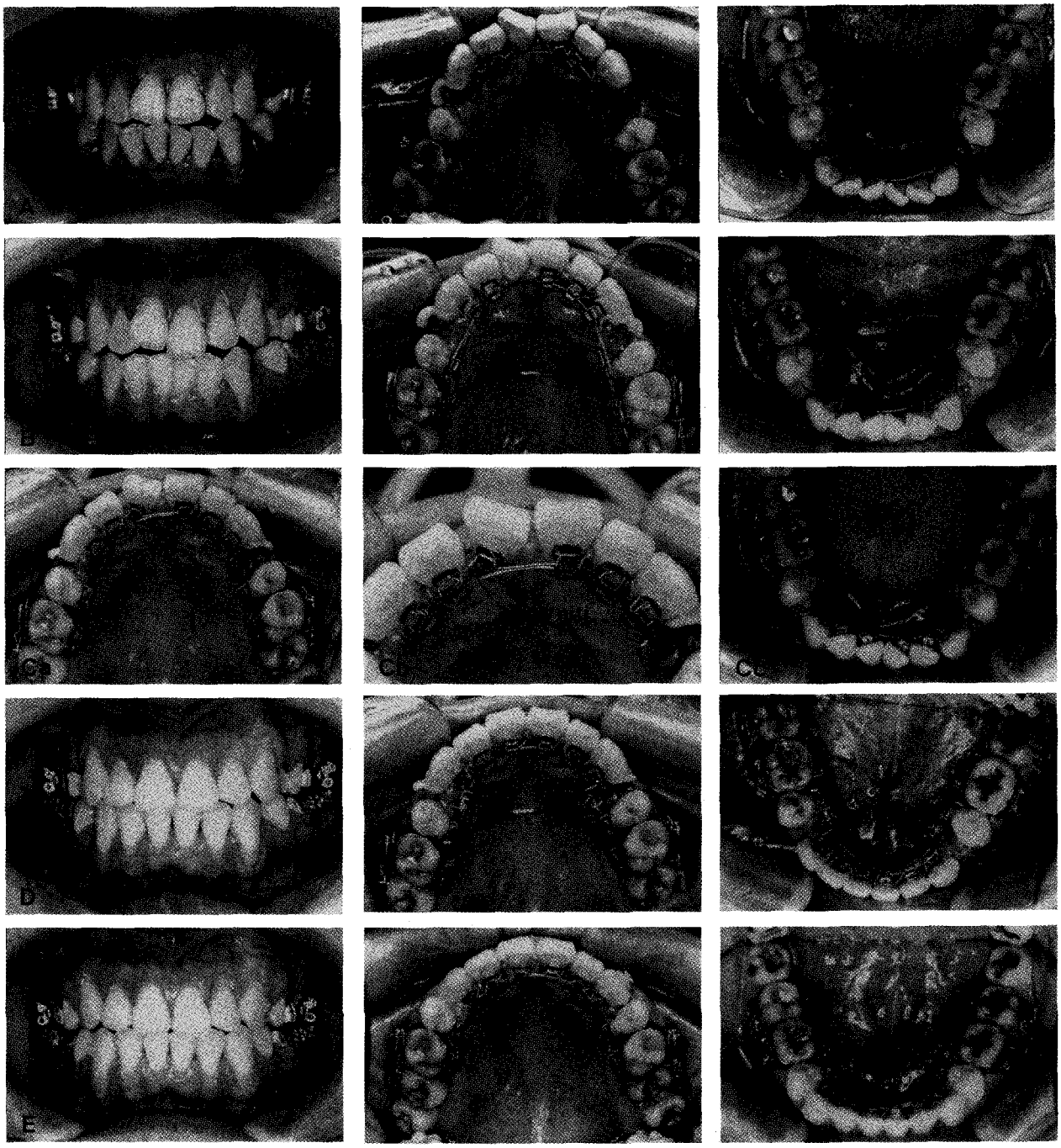

Fig 9. A: 0.012 inch nickel titanium mushroom archwires placed in upper and lower occlusal slots; B: Partial canine retraction with elastic thread (ET) on 0.016 inch stainless steel mushroom archwire engaged in lingual slots; C: Further alignment of any remaining crowded teeth; a, b: Tandem archwire system for correcting the rotated upper right central incisor: 0.012 inch nickel titanium segment in anterior occlusal slots; rigid 0.016 inch stainless steel mushroom archwire in lingual slots; c: 0.012 inch nickel titanium mushroom archwire placed in lower occlusal slots; D: 0.018 × 0.018 inch stainless steel closing-loop mushroom archwires placed in upper and lower occlusal slots; E: 0.016 × 0.016 inch stainless steel mushroom archwire with L-loops in upper occlusal slots for linguoversion of the upper right second bicuspid.

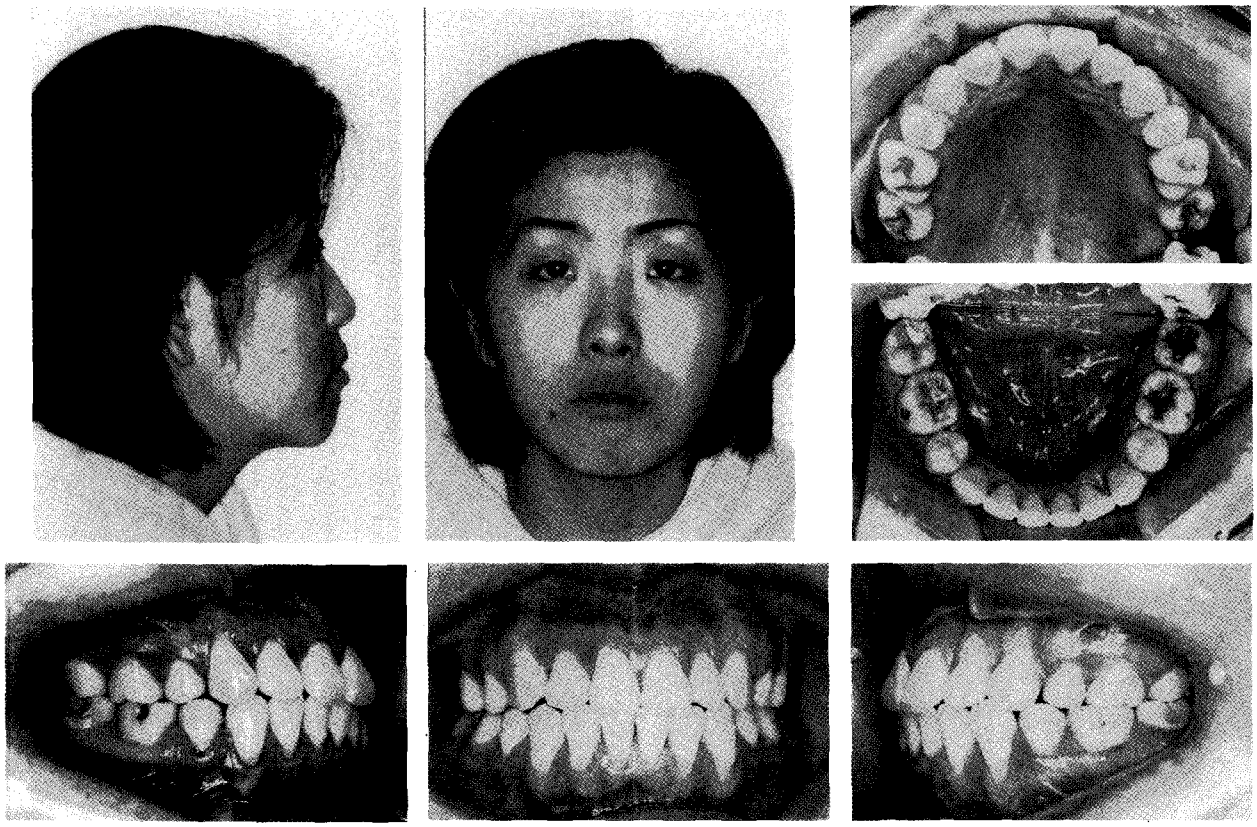

Fig 10. Posttreatment facial and intraoral photographs.

a dolichofacial pattern, as evidenced by an FMA angle of 31.8° (Table 1).

The treatment plan included extraction of four first premolars to correct the lip protrusion.

In the laboratory, the upper and lower incisors were repositioned on the setup cast according to treatment objectives. U-1 to FH of the setup was adjusted to 120°, which is the pretreatment value. Lower incisors on the setup were proclined 3 degrees. So the setup value of L-1 to FH became 46°. In this way, unnecessary lingual crown torque was not given to the upper anterior bracket and 3 degrees of lingual root torque were added to the lower anterior bracket.

Fujita lingual brackets were customized and indirectly attached to the upper and lower teeth that had sufficient space for the brackets to be bonded.[18,20] Standard edgewise appliances were buccally attached to the upper and lower first and second molars. The maxillary and mandibular teeth were aligned with a progression of mushroom archwires, starting with 0.012 inch nickel titanium up to 0.016 inch stainless steel (Fig 9A). After 3 months of alignment, 0.016 inch stainless steel mushroom archwires were inserted into the lingual slots of both arches and partial canine retraction with elastic threads was initiated in all four quadrants (Fig 9B). After space was obtained, any crowded tooth that had not previously received a bracket was indirectly bonded and further alignment was continued with lighter archwires (Fig 9C). After 11 months of treatment, 0.018 × 0.018 inch stainless steel closing-loop mushroom archwires were placed in the occlusal slots of both arches to begin en masse retraction (Fig 9D). Cervical

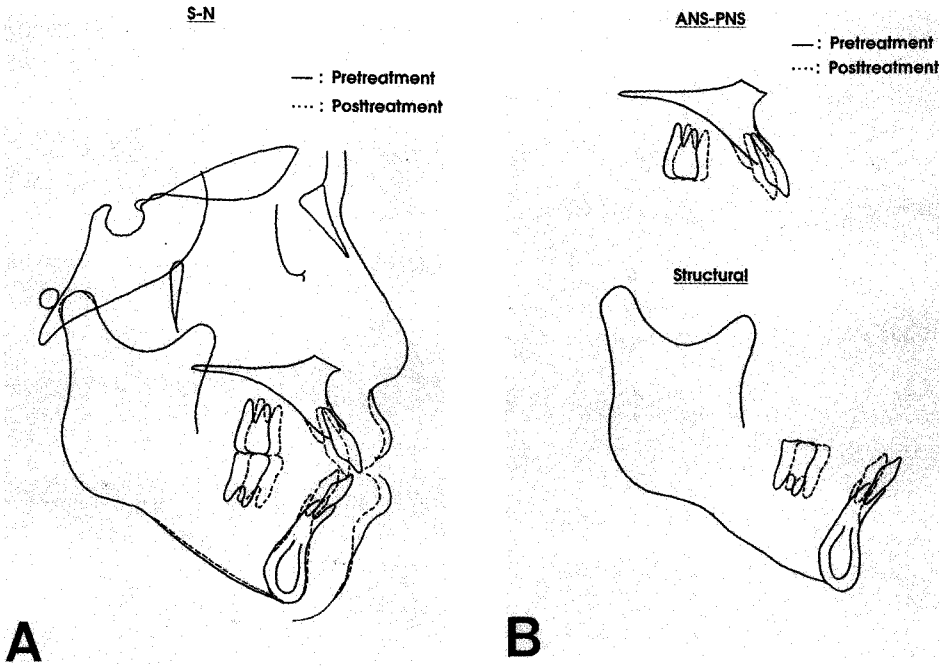

Fig 11. Superimpositions of pretreatment and posttreatment cephalometric tracings; A: Overall superimposition shows no downward and backward rotation of the mandible. There was an improvement in lip relation, with favorable lingual retrusion; B: In regional superimpositions, the maxillary and mandibular incisors were favorably retracted with careful control of the axial inclination. The maxillary and mandibular molars moved mesially.

headgear, transpalatal arch, and anterior diagonal elastics were used to assist en masse retraction. After 9 months of space closure, a 0.016 × 0.016 inch stainless steel mushroom archwire with L-loops was placed in the upper occlusal slots to move the upper right second bicuspid lingually (Fig 9E). The appliances were removed 23 months after the start of treatment and a maxillary removable circumferential retainer and a mandibular bonded lingual retainer were delivered.

The lip protrusion was improved, and favorable inter-digitation with Class I occlusion was achieved (Fig 10).

The cephalometric analysis with superimposition of tracings showed the movement of the maxillary and mandibular incisors (Table 1; Fig 11). Retraction of the maxillary and mandibular incisors was achieved with good control of axial inclination.

DISCUSSION

In labial orthodontics, a study[21] showed that during orthodontic correction of bimaxillary protrusion, the maxillary incisors were uprighted to their base, by 12.43 degrees. In this lingual orthodontic case, the U1-FH angle decreased 5.8 degrees during treatment. The decrease in the axial inclination of the upper incisors to their base for labial orthodontic case is 6.63 degrees greater than for lingual. These results support the hypothesis that the incisor inclination indicator is useful for torque control of the anterior teeth during retraction in lingual orthodontic treatment.

CONCLUSION

As there is a tendency toward retroclination of upper

and lower incisors during retraction, torque control of the incisors is an essential part of good orthodontics, especially in lingual orthodontic treatment. With the incisor inclination indicators, adequate or additional torque can be built into the resin backings of the anterior lingual bracket bases. As shown here, the pretorqued anterior lingual brackets can achieve the desired tooth movements of the incisors during retraction in bimaxillary dentoalveolar protrusion cases, making it simpler to obtain an adequate anterior torque without placing third order bends in the anterior portion of the lingual mushroom archwire. These results indicate that the use of the incisor inclination indicator is an effective adjunctive laboratory procedure for anterior torque control during retraction in lingual orthodontic treatment.

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국문초록

설측교정치료에 있어서 전치부 후방 견인시 토오크 조절을 위한 incisor inclination indicator

홍윤기[a], 김태건[b], 김태우[c]

진단용 셋업 모형 제작시 전치의 치축을 조절하기 위하여 incisor inclination indicator란 장치가 소개되었다. 이것은 상하악 전치의 후방 견인시 토오크 조절을 위하여 사용된다. 본 논문에서는 incisor inclination indicator를 사용하여 전치부 설측 브라켓에 적절한 토오크를 처방하는 방법을 묘사하고 이렇게 적절한 토오크가 처방된 전치부 설측 브라켓으로 치료한 양악 전돌증 환자의 치료 결과를 평가한다. 후방 견인시 상하악 전치는 토오크가 적절하게 조절되었다. 설측교정치료에 있어서 incisor inclination indicator는 기공 과정에서 부가적으로 사용되어 전치부의 후방 견인시 효과적으로 토오크 조절을 할 수 있는 것으로 생각된다.

주요 단어 : 설측교정치료, Incisor inclination indicator, 토오크가 미리 처방된 전치부 설측 브라켓, 전치부의 조절된 후방 견인

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